



Effects of different soil tillage methods and fertilization on potato crop

Roberto Mancinelli¹, Verdiana Petroselli¹, Mohamed Allam¹, Emanuele Radicetti²

¹ University of Tuscia, DAFNE Dept., IT; Correspondent author: mancinel@unitus.it

² University of Ferrara, DOCPASDept., IT

Introduction

Tillage intensity is being gradually reduced under various farming systems by the application of more environmental-friendly strategies based on alternative soil tillage methods. The use of composted organic waste can help in managing organic matter in the soil and could represent a key for sustainable agriculture. The main objective of this study was to evaluate how soil tillage (plowing, ripping and spading), fertilization source (mineral and organic) and weeds affect potato crop production.

Materials and Methods

The field trial was carried at University of Tuscia in Viterbo. The soil characteristics are: 63% sand, 22% silt and 15% clay; organic carbon 1.07%, total nitrogen 0.12%, pH 7.1. The weather conditions, measured in an automating weather station located near the field experiment, were similar to that observed in the long term period (30-year). The experimental treatments were: (i) two fertilization types [mineral fertilizers (M); organic fertilizer (O) (composted urban organic waste)]; (ii) three tillage methods at a depth of 30 cm [plowing tillage (P), sub-soiling tillage (R), and spading tillage (S)]. A complete randomized block design with three replications was applied. The soil was tilled following the above-mentioned treatments and, then, it was harrowed in order to break soil clods for the seed bed preparation. The organic fertilizer (15 t ha⁻¹) was distributed in one application before the harrowing. Mineral fertilizers were applied according to the practices adopted in the study area by distributing the phosphorus (80 kg ha⁻¹) before the harrowing, and the nitrogen at the seeding (50 kg ha⁻¹) and after a month (50 kg ha⁻¹). Potato var. Monnalisa was sown on April 2nd, 2014 and April 14th, 2015, harvested on July 29th, 2014 and July 10th, 2015. Aboveground biomass and yield, and weeds were collected from a 1 m² quadrant. Data were statistically analyzed by analysis of variance (ANOVA). Fisher's protected least significant differences (LSD) test at the 0.05 probability level was used for mean comparisons.

Results

The measured weather conditions during the potato growing seasons tended to be different in the two experimental years. The highest yield of marketable potato tubers observed in 2014 could be due to well distributed precipitation throughout potato growing season and reduced temperature compared with 2015. In fact, potato crop is extremely sensitive to water stress and high temperature, especially in late season when the potato canopy is dry and the soil is highly exposed to solar radiation. Potato yield in terms of commercial tubers and potato straw were significantly affected by growing season x soil tillage and by fertilization source x soil tillage (Table 1).

The fresh weight of commercial tubers varied from 1725 to 732 g m⁻² and tended to be higher in plowing treatment in both potato growing seasons, followed by spading machine and it was lower in subsoiling treatment (Table 1). Although the highest commercial tuber yield was observed in plowing tillage under mineral organic fertilization, the average commercial tuber was tendentially higher in mineral compared with organic fertilization source (on average 1380 vs. 1160 g m⁻²). Moreover, spading machine performed better under mineral fertilization source (Table 1). The relationship between commercial tubers of potato and weeds was affected by soil tillage and fertilizer source treatments. Generally, tubers resulted to be significantly related to weed density under sub-soiling tillage (R) and spading tillage (S) and both fertilization sources (Fig. 1). While weed biomass affected the commercial tubers in plowing and subsoiling tillage and under only organic fertilizer source (O).

		Commercial tubers (g m ⁻²)	Straw (g)
2014	P	1751.1b	76.9c
	R	731.7a	57.5d
	S	1638.4c	106.0b
2015	P	1724.9d	143.3a
	R	756.8ab	92.5bc
	S	1020.9c	89.0bc
M	P	1495.5b	105.0ab
	R	914.8c	82.1bc
	S	1731.5ab	113.8a
O	P	1980.5a	115.3a
	R	573.7d	67.8c
	S	927.8c	81.1c

Table 1 - Potato yield and straw. Values with different letters are statistically different.

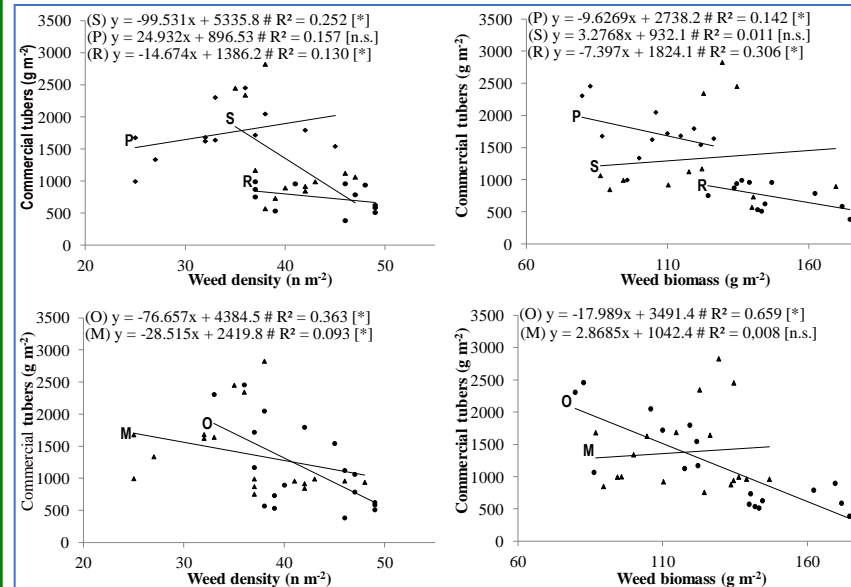


Figure 1 – Commercial potato tubers related to weed density and weed biomass.

Conclusions

This study demonstrated that weed management represents a key factor for the adoption of alternative soil tillage and fertilizer source as their adoption affect both commercial tuber of potato and weed characteristics, in terms of density and biomass. The adoption of spading machine could be considered as an alternative agronomical practice able to keep a satisfactory tuber yield and weed management. Further studies should be performed to assess how each management practice can affect the weed community composition to address farmer's choice to sustainable approach for crop cultivation.